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Comparison of the Effectiveness of Microalgae Harvesting with Filtration and Flocculation Methods in WWTP ITDC Bali

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ABSTRACT

To increase tourism in Bali Island, in the year 1971 Government assisted by United Nations Development Programme conducted a study about Bali tourism. That study suggested that more international hotels should be built in Bali Island to accommodate the increment of foreign and domestic tourists. Statistic data issued by Central Statistics Agency of Indonesia showed that the number of tourists in the year 2016 has increased 23.14% compared to the previous year. The Nusa Dua Project is a part of the Bali tourism development master plan. Domestic waste water from hotels in Nusa Dua region needs to be treated, so Bali Tourism Development Corporation Waste Water Treatment Plant was built in 1976 which later changed its name to the WWTP Indonesia Tourism Development Corporation (ITDC). However, the final processed product at WWTP ITDC Bali is still affected by algae bloom which reducing water quality. The existing practice to harvest microalgae is based on flocculation method using alum & polyelectrolyte chemicals causing the harvested microalgae contaminated by chemicals. The purpose of this study is to compare two different methods of microalgae harvesting namely filtration and flocculation methods, to know the effective filtration method based on slope and pressure variations, and to recommend the utilization of the dominant type of microalgae. The microalgae harvesting by using filtration was made in various variations, namely variations in water pressure and slope. In the variation of water pressure, three stages are carried out, namely the pressure of 1.5 bar, 2.5 bar, and 3.5 bar which each pressure was done for 10 minutes, 20 minutes, and 30 minutes. In the slope variation, there were 3 stages, namely pressure 10°, 20°, and 30° which each pressure was carried out for 10 minutes, 20 minutes, and 30 minutes. From the results of the harvesting water quality test microalgae that is effective and in accordance with the WWTP ITDC Bali vision and mission, that is *go green* or *green company, the* parameter concluded that has the highest lowest value is using the method of harvesting microalgae filtration with a pressure variation of 1.5 bar. Because harvesting microalgae by filtration method does not use any chemical mixture. Effective slope variation filtration method is at 10° in 30 minutes with a weight of 203 grams, while the effective pressure variation filtration is at 1.5 bar in 30 minutes weighing 212 grams. This is because the weight of microalgae is filtered the most. The dominant in the whole sample is *microalgae Gramatophora angulosa* which belongs to the class of algae brown *(Phaephyceae)* and *Sphaerocystis schroeteri* which belongs to the class of green algae *(Chlorophyceae)*. Benefits of algae brown *Gramatophora angulosa* as an ingredient in organic fertilizer and animal feed. Benefits of green algae *Sphaerocystis schroeteri* as freshwater fish feed ingredients.

Keywords: microalgae, WWTP, algae blooms, filtration

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INTRODUCTION

In the framework of the Bali Tourism development business, in 1971 the Government assisted by the United Nations Development Programme initiated a study of Bali Tourism that was conducted by Societe Centrale pour l'Equipement Touristique d'Outre-Mer - Central Company for Overseas Tourist Facilities (SCETO), a consultant from France. The study suggested that more international hotels shall be built in Bali Island to accommodate foreign tourists who are expected to keep on growing. Then Nusa Dua Tourism Region was developed to fulfill the need for high quality hotel rooms. In the year of 1975, it was estimated that there were only 1800 rooms built in Kuta and Sanur, which were of international standard, while according to studies until 1980 there were around 3800 - 4700 international standard hotel rooms. The archetype of the Bali Tourism master plan, as recommended by the SCETO team is an economic development, where the standard of living and welfare of the people is improved without sacrificing cultural values and the social structure of Balinese life and the environment (Bali Province, 2017).

The Nusa Dua Project, as part of the Bali Tourism development master plan, is a development of a tourism area with a centralized tourist settlement, which is far from the center of the daily life of Balinese people in general. Thus the direct influence of tourists, especially negative influences can be suppressed. The land that is eligible is in the hill area, namely Nusa Dua, a land that is not productive, but has a beautiful beach and white sand, sparsely populated and very close to Ngurah Rai Airport. The location of the land, separate from the traditional Balinese community. Through this approach, as explained above, it is expected that the need for ever-increasing rooms can be met, as well as Balinese culture as the main attraction of Tourism can still be preserved. Besides that, the Nusa Dua area is easier to develop because the available land is quite extensive and the population is rare. Rainfall is relatively small and there is no surface water source, so the soil is infertile for agriculture. No less important consideration is that Nusa Dua has an attractive natural landscape with white sandy beaches, clear sea water and the beach facing the rising of the morning sun. The location of accommodation / hotel as one of the main components of the area is recommended in the South Badung area, close to Ngurah Rai Airport and easier to get utility services and other conveniences from downtown Denpasar, rather than Karangasem and West Bali (Bali Province, 2017).

The Tourism Area is prepared with the economic use of available land, without disturbing the environment, while the infrastructure and facilities are optimally utilized for the construction of hotels and other tourism facilities. The location of the hotel is along the beach with the center of the Amenity Core activity built in accordance with the Balinese countryside with a spacious courtyard and distinctive architecture. In the framework of developing the Nusa Dua project as an integrated Tourism Zone there are 3 main components, namely the provision of Infrastructure and Facilities, improvement of road lanes leading to areas that will be visited by tourists and improvement of road lanes to areas that will be visited by tourists.

In the framework of implementing the Nusa Dua plan, as a Tourism Zone a Business Entity has been established, namely PT. Bali Tourism Development (Persero) or better known as the Bali Tourism Development Corporation (BTDC), whose main purpose is to provide infrastructure and facilities, inviting investors to build hotels and manage and maintain the Nusa Dua Tourism Area. In addition, the Development Agency of the Bali Tourism Master Plan (BTMP) was formed with the task of consultation and coordination with the PP. No.27 of 1972 and PT. Bali Tourism Development (Persero) or Bali Tourism Development Corporation (BTDC) (Bali Tourism Development Corporation, 2017).

In Nusa Dua Bali there is a waste handling unit in the form of a lagoon / pond system consisting of 9 ponds, to handle liquid waste from all hotels in the Nusa Dua tourism area. Hotel liquid waste is domestic waste with high organic matter content, so it cannot be separated from the activity of heterotrophic organisms such as algae. Nusa Dua Tourism Area is one of the best tourism destinations in the world today. For more than 40 years, the realization of Nusa Dua development has consistently followed spatial zoning, coastline boundaries, landscape concepts, utility designs and security systems as stated in the development master plan prepared in 1972 (Bali Province, 2017).

Currently in Nusa Dua there are 19 star hotels offering 5,000 rooms, shopping centers, museums, cultural sites, golf courses, hospitals and other tourism businesses. With two internationally-owned MICE facilities, Nusa Dua has hosted various international events including the 2007 United Nations Climate Change Conference, 2013 APEC, the Bali Democracy Forum, and 2013 Miss World. Managed consistently with the concept of environmentally friendly, Nusa Dua has received various awards such as Kalpataru from the Government of the Republic of Indonesia and the certification of Tri Hita Karana from the Tri Hita Karana Bali Foundation. At the global level, in 2004, Nusa Dua received the first Green Globe 21 Asia Pacific

Certification in the world for the "Community Resort" category provided by the Green Globe Foundation, a global institution supported by the United Nations (Bali Tourism Development Corporation, 2017).

The Central Statistics Agency (BPS) of Bali recorded 4.92 million foreign tourist arrivals in 2016. This number increased by 23.14% compared to the previous year of 4.0 million people. They came by riding a plane that flew directly from their country through Ngurah Rai Airport as many as 4.85 million people and the remaining 75,303 people through the sea port, "said the Head of the Bali Provincial BPS, Adi Nugroho in Denpasar, as quoted by18/2 *Antara on*Saturday (/ 2017) Adi Nugroho added, specifically for December 2016 tourists to Bali were 442,800 people, who came through Ngurah Rai Airport 437,946 people and through the sea port 4,854 people, this number increased by 19.47% compared to the same month the previous year (December 2015) or also increased by 7.16% compared to November 2016. While in 2017 the Provincial Government of Bali's Tourism Service is targeting to bring in 5.5 million foreign tourists (Debora, 2017).

The Sustainable Development Goals abbreviated as SDGs include 17 goals with 169 measurable achievements and deadlines that have been determined by the United Nations, a world development agenda for the benefit of humans and earth. This goal was jointly proclaimed by intergovernmental countries in the UN resolution published on October 21, 2015 as ambitions for joint development until 2030. This goal is a continuation or substitute for the Millennium Development Goals signed by leaders from 189 countries as the Millennium Declaration at UN headquarters in 2000 and no longer valid since the end of 2015. The 6th objective of the SDGs is to guarantee access to water and sanitation for all. Thus, the construction of the WWTP BTDC supports the 6th SDGs aim of ensuring access to water and sanitation for all. In its development, this waste treatment system was not only developed in Bali but also began to be developed in tourism areas in Lombok, then the name BTDC was changed to ITDC (Indonesia Tourism Development Corporation) (Bali Tourism Development Corporation, 2017).

Liquid waste that is processed in the lagoon of ITDC is domestic liquid waste from hotels such as bathroom waste, toilet, laundry, swimming pool, air conditioner (AC), kitchen and all hotel activities that use water. Each hotel accommodates waste from each part of the hotel or restaurant in a collection pit which is then pumped into the main sewage pipeline of WWTP ITDC. From the main waste pipe, the waste will flow in gravity towards pump station elevator the nearest (LPS) and the submersible pump at LPS will work automatically pumping the waste into the lagoon of ITDC which is approximately 2 km north of the area.

The wastewater treatment system that is applied is the Waste Stabilization Pond. Fresh waste from LPS goes through the inlet in cell 1 and undergoes an oxidation process. Cell 1 consists of 2 parts (1a and 1b) which are separated by fiberglass at the top which serves as a tool to trap fat (*grease trap*) to reduce fat and floating impurities that enter the next cells. Fats and dirt that are retained by fat traps are routinely cleaned by workers manually. After passing cell 1 (process), the water flows into cell 2a, then flows to cell 2b (the widest cell). In cells 2a and 2b the oxidation process takes place long enough (because it is very wide) and the formation of suspended solids occurs due to the activity of algae and heterotrophic bacteria so as to accelerate the deposition of organic substances and release of gas into the air. As an indicator of control of water toxicity, *mujair* fish (*Oreochromis mossambicus*) have been released in this cell which can be used as a biological indicator to find out the changes in quality in it. Then the water flows into cell 3 with a stabilization pond system, the water conditions at the bottom of the pond are anaerobic, and due to day and night causes facultative zones. Layout plan of those cells are presented in **Figure 1** (Bali Tourism Development Corporation, 2017). The main problem experienced by the WWTP ITDC management is algae bloom. Every pond water cell is green. Until the outlet pond as the last processing pond, the water is still green (see **Figure 2**). The green color produced by algae affects the quality of the treated water at the WWTP ITDC Nusa Dua Bali Dua. From these problems, it is necessary to identify the type of algae that presence in the Nusa Dua Bali WWTP pond so the more effective method to harvest algae either by using filtration or flocculation can be determined including their utilization.

Figure 1. Site Plan Instalation in WWTP ITDC Bali

Figure 2. Existing Condition of Pond Outlet WWTP ITDC Nusa Dua Bali Algae Contaminated

Existing conditions for the algae harvesting method at the WWTP ITDC Nusa Dua Bali are using the flocculation method. The flocculants material used for algae harvesting is using alum $K_2SO_4.Al_2(SO_4)_3.24H_2O$ and polyelectrolyte. The process of taking the water to be harvested using the flocculation and coagulation method comes from the pond of cell 3, then put into the tub to be mixed with alum $K_2SO_4.Al_2(SO_4)_3.24H_2O$ and polyelectrolyte. A container of microalgae harvesting results using a flocculation machine that is 7m x 3m x 1m, and can accommodate the volume of microalgae harvesting in the form of 18m$floc^3$. At this stage there is the incorporation of algae deposit nuclei so that it becomes a larger molecule, at this stage a slow stirring is carried out at 40-50 rpm for 15-30 minutes. To accelerate the formation of floc, polyelectrolyte flocculants are added. The nature of polyelectrolytes is having the ability to remove color, and is efficient for the process of separating water from algae clots. Algae floc in microbiological harvesting was formed after 24 hours with cell densities between 10.1 x 10^8 cells / ml to 12.3 x 10^8 cells / ml. Separation Phase Algae Floc with Floc Fluid formed later must be separated from the liquid, namely by flotation. Algae floc is floated using dissolve air flow, then the floc can be taken using a skimmer.

After getting microalgae from the result of flocculation, the microalgae is then processed to be used as compost. It is feared that if there is influence of alum in microalgae harvesting, it will also affect the yield of compost that will be used for crop maintenance in the Nusa Dua tourism region, so it may be less environmentally friendly. The residual results from harvesting use flocculation microalgae harvesting method with alum namely $Al(OH)_3$ (Aluminium hydroxide) (Hidayati, 2015). Aluminium hydroxide can accumulate in plants and cause health problems for animals that consume these plants. High aluminum concentrations not

Table 1. Comparison of advantages and weakness between two methods

Method	Advantages	Weakness
Filtration	Small energy: Easy to do	Many factors must be considered in the selection of filters, such as the size and morphology of the cell, reactor volume.
Flocculation	Small energy: Easy to do	Using chemicals and difficult to remove from microalgae.

Table 2. Comparison of efficiency between two methods

Method	System	Microalgae	Efficiency	Researcher
Filtration	Continue	*Chlorella vulgaris*	58%	Syarif (2008)
	Tangential flow	-	70 – 89%	H. Bernhardt and J. Clasen, J. (1994)
	Chamber filter press	*Coelastrum proboscideum*	27%	Mohn (1980)
	Discontinuous pressure filter	*C. proboscideum*	22 – 27%	Mohn (1980)
	Discontinuous vacuum filter	*C. proboscideum*	37%	Mohn (1980)
	Semi - continue	*Chlorella sp.*	38%	Chiu (2008)
Flocculation	pH 10,2	*Skeletonema costantum*	80%	Blanchemain dan Grizeau (1999)
	pH 11	*Chaetoceros calcitrans*	≈100%	Harith (2009)
	$(Al_2(SO_4)_3)$	*Chlorella. Vulgaris*	72%	Oh (2001)
	Polyacrylamide	*Chlorella. Vulgaris*	78%	Oh (2001)
	Paenibacillus sp. AM49	*Chlorella. Vulgaris*	84%	Oh (2001)
	pH 11	*Chlorella. Vulgaris*	86%	Oh (2001)
	Fe^{3+}	*Various*	80%	Knuckey (2006)
	Electroflocculation	*Chlorella. Vulgaris*	> 90%	Vandame D

only have an effect on fish, but also on birds and other animals that consume contaminated fish and insects and animals that breathe in aluminium through the air. The consequences for birds that consume fish contaminated with thinning eggshells and chicks with low birth weight. The consequences for animals that breathe in aluminium through the air may be lung problems, weight loss and decreased activity (Tatang, 2015).

Harvesting using this flocculation method has been operated by the WWTP ITDC Bali starting in May 2017 and costs 500,000,000 IDR for the construction of storage equipment for the flocculation process and the results of harvesting, also includes installation costs for filtering water from pond cell 3 to water reservoirs.

As technology develops, microalgae harvesting methods also develop. Various methods have been created, from methods that work mechanically / physically to methods that use chemical. Some methods that have been carried out are filtration, centrifugation, and flocculation (Brennan, 2009) and the comparison of both of method explain in **Table 1** and **Table 2**. **Table 1** showed the comparison of advantages and weakness, while **Table 2** explained the comparison of efficiency between those two methods.

The first method is filtration. This method works by holding / filtering solids (microalgae) with the medium being flowed. After filling with microalgae, the filter is taken to measure the retained biomass. The next method is centrifugation, which is a separation method based on density using centripetal force. A larger density microalgae will be held in the bottom of the tube. The last method is flocculation. Flocculation is a method of harvesting by forming microalgae in a larger collection so that it is easy to extract biomass. To form a collection, microalgae are flocculants which can be in the form of chemicals, such as alum and NaOh, and natural ingredients, such as chitosan.

Filtration methods are often used for harvesting filamentous algal strains. It was explained that high flow rate algae ponds are easier to harvest for filamentous algae with a micro filter to maintain large cells and remove smaller, non-filamentous algae (Vonshak and Richmond, 1988., Wood, 1987). Other studies have revealed that the species of algae that are dominant in the species cannot be ascertained (Hoffmann, 1998). Types of filamentous algae are less suitable for applications as biofuels because they have less fat content (Mulbry *et al.*, 2008).

Thus, the purpose of this study was to determine the type of algae that most influences the water quality at the WWTP ITDC, and to compare the effectiveness of the algae extraction of the filtration and flocculation methods along with the benefits of harvesting these types of algae.

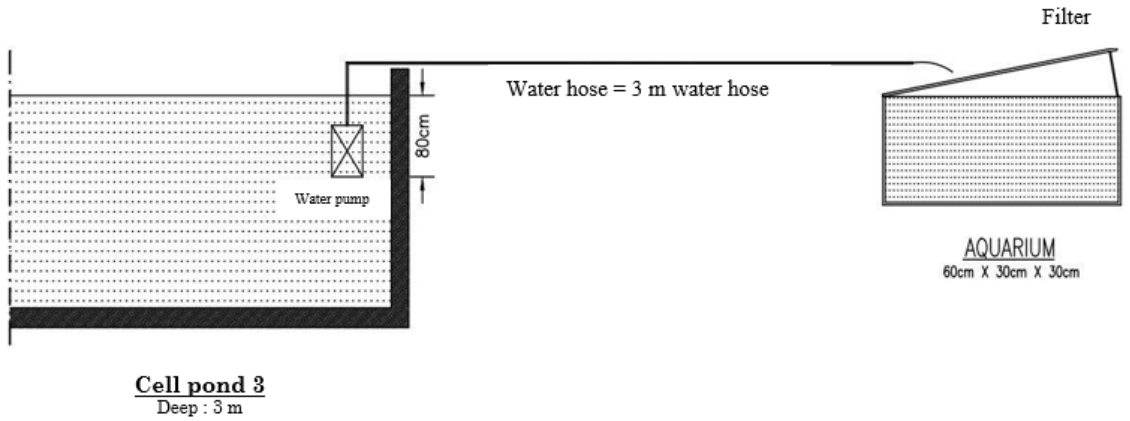

Figure 3. Nanofiltration Method of Slope Variation Filter

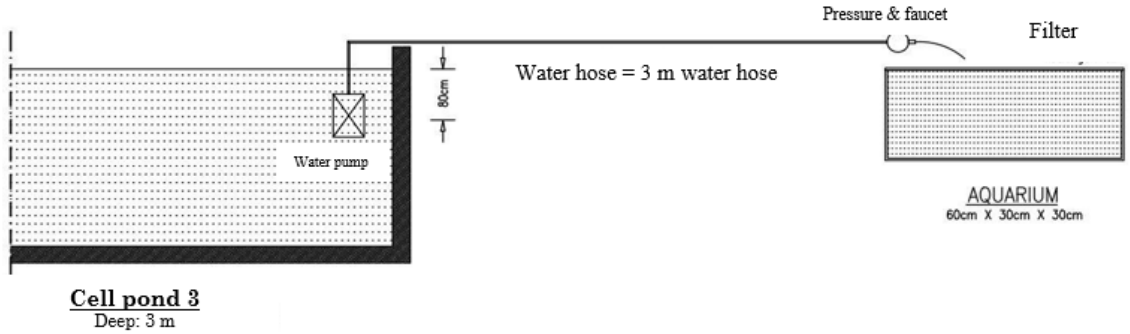

Figure 4. Nanofiltration Method of Water Pressure Variation

METHOD

Materials and Methods

Sampling was carried out using filtration and flocculation methods from water pond cell 3. Two variations were used for filtration methods, namely filter slope position and water pressure using a 60 x 35 cm aquarium and 38 watt aquarium pump.

Filtration with Slope Variations

The filter uses monyl/screen T54 cloth, then for the variation of the slope of the filter i.e. 10°, 20°, and 30°, 3 water samples were taken every 10 minutes for water quality test. 1 L of water is taken for each slope variation and for the type of algae, 600ml of water is taken for each slope variation, from cell 3 to the aquarium by pumping an aquarium's pump (see **Figure 3**).

Filtration with Pressure Variations

For 3 water pressure variations, 1.5 bar, 2.5 bar, and 3.5 bar were taken, each filtered for 30 minutes and filtered for every 10 minutes for water quality test. 1L of water is taken for each variation of water pressure and for the type of algae is taken 600 ml each slope variation, from cell 3 to the aquarium by pumping an aquarium's pump with variations of pressure (see **Figure 4**).

Laboratory Scale Flocculation

Testing was made on a laboratory scale by adding alum & poly flocculant materials to 5 L of cell 3 pond water, then fast stirring for 1 minute using a mixer and stirring for 15 minutes using wood, then doing dissolved air flotation for 30 minutes with a bubble pump, after floating, it is filtered using a skimmer and the result is taken 1 L to test the water quality and 600 ml for the algae type test. Algae type tests are carried out with two types of testing, namely qualitative and quantitative tests and explained in the **Figure 5**, the existing conditions from field we make a laboratory scale flocculation with aquarium.

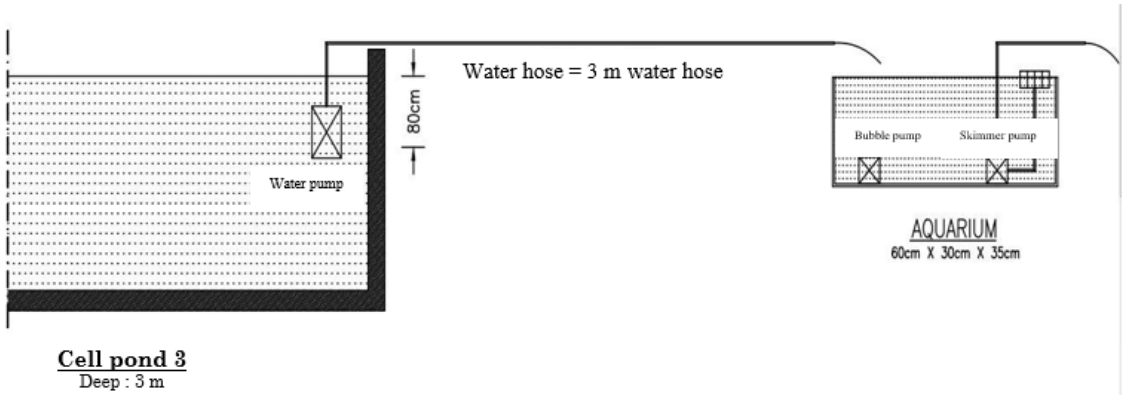

Figure 5. Laboratory Scale Flocculation Method

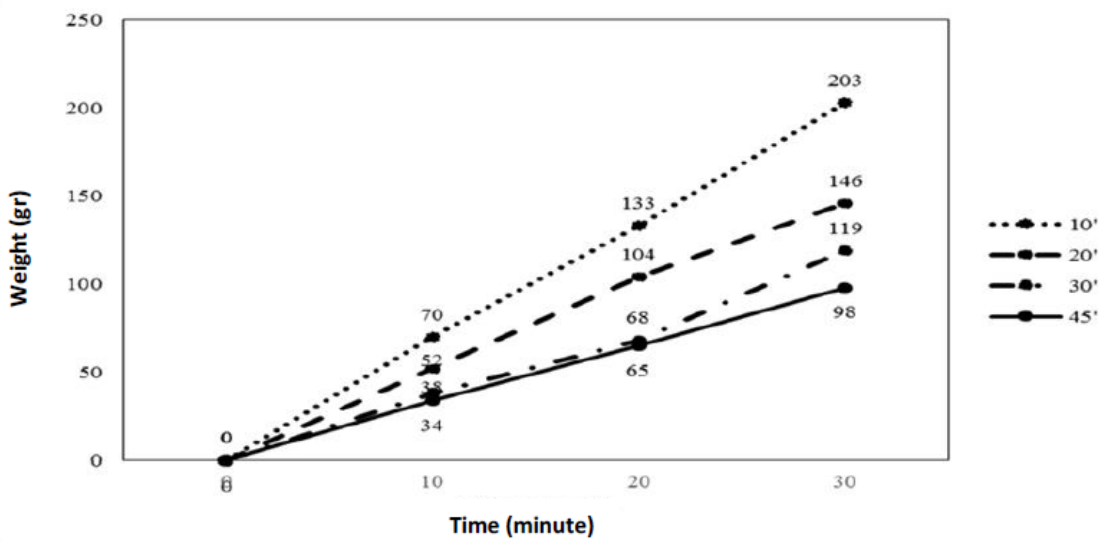

Figure 6. Relationship of Weight and Time on Various Slope of Filter Position

RESULTS

Microalgae Harvesting Method of Flocculation

From the data studied in the health laboratory of Bali Province, it was explained that those that meet the standard are only pH values, this is due to the addition of flocculants chemicals in the form of alum $K_2SO_4.Al_2(SO_4)_3.24H_2O$ and polyelectrolyte (Thompson *et al.*, 2010). This is not in accordance with the vision and mission of the WWTP ITDC that applies the principles of go green (eco-friendly) and conventional.

Microalgae Harvesting Slope Cariation Filtration Method

From the data above shows that with the algae harvesting filtration method with a variety of slopes the optimum results with maximum algae weight are obtained at a slope of 10 ° and at 30 minutes. Because the weight of the filtered algae weighs 203 grams. This is because it is influenced by the slope elevation of the filter position, because the higher the slope, the more algae that pass and are not filtered, this is due to the slipping of some solids so that they return to the bottom (Asli - Ardeh & Mohsenimanesh, 2012), so that the filter slope elevation position is flat the more algae that will filter.

From the graph above shows that the higher the slope, the higher the value of Suspended Solids Dissolved Solids (TDS). This is because the more sloping the nanofiltration surface, the more TSS substances are dissolved in filter water through the bottom of the filter slit because of the increasingly steepness of this matter due to the slipping of some solids so that they return down (Asli - Ardeh & Mohsenimanesh, 2012). **Figure 6** explain that graphics of relationship of weight and time on various slope of filter position. **Figure 7** explain that contains of value of TDS & TSS with slope.

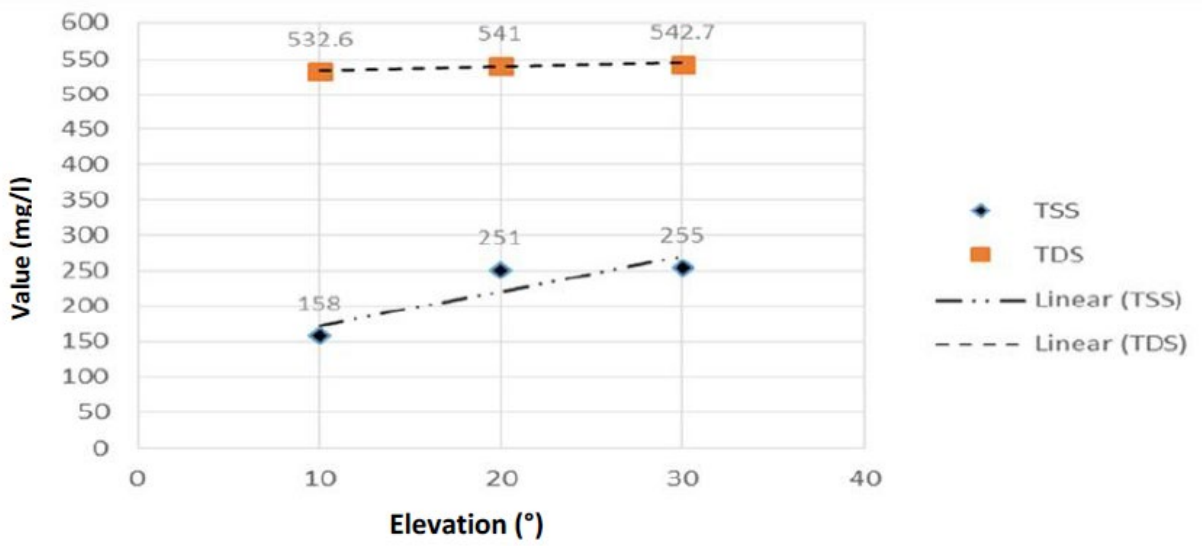

Figure 7. Relationship of TDS & TSS values with Filter Position Slope

Table 3. Result of Water Quality from Filtration with Pressure 1,5 bar

No	Elements	Method	Unit	Maximum allowed	Field Inspection Results	Laboratory Examination Results
1	Total Suspended Solids (TSS)	Spectrophotometry	mg/l	50	611	607.2
2	Total Dissolved Solids (TDS)	Electrometry	mg/l	-	265	288
3	pH	Electrometry	-	6 sampai 9	7.26	7.12
4	Free Ammonia (NH_3.N)	Nessler	mg/l	10	13.38	12.28
5	BOD_5	Titrimetry	mg/l	28	32.16	37.46
6	COD	Titrimetry	mg/l	50	120	130
7	Methylene blue active compound	Methylene blue	mg/l	5	0.021	0.021
8	Oil and fat	Gravimetry	mg/l	10	<0.1	<0.1
9	Total N	Spektrofotometri	mg/l	5	14.848	13.712
10	Total P	Spektrofotometri	mg/l	0.1	1.362	1.299

Microalgae Harvesting Water Pressure Variation Filtration Method

From the data above shows that the algae harvesting filtration method with various variations of water pressure obtained optimum results with maximum algae weight at 1.5 bar and 30 minutes. Because the weight of the filtered algae weighs 122 grams. This is because the higher the pressure generated by the pump, the less algae will be collected because many algae spurt back and spread into narrow gaps between the aquarium and filter (Burger & Concha, 2001). **Table 3** explain the result of the best water quality from filtration with pressure 1.5 bar.

From the graph above shows that the higher the water pressure, the higher the TDS value, TSS value, the value of Free Ammonia, the Total N, and values Total P. This is because the tighter the water bursts on the surface of the nanofiltration, the more Total P passing through high pressure and not filtered perfectly on filtration (Burger & Concha, 2001). **Figure 8** explain that graphics of relationship of weight and time on various pressure of filter position. **Figure 9** explain that contains of value of Ammonia free, TDS, and BOD_5 with pressure.

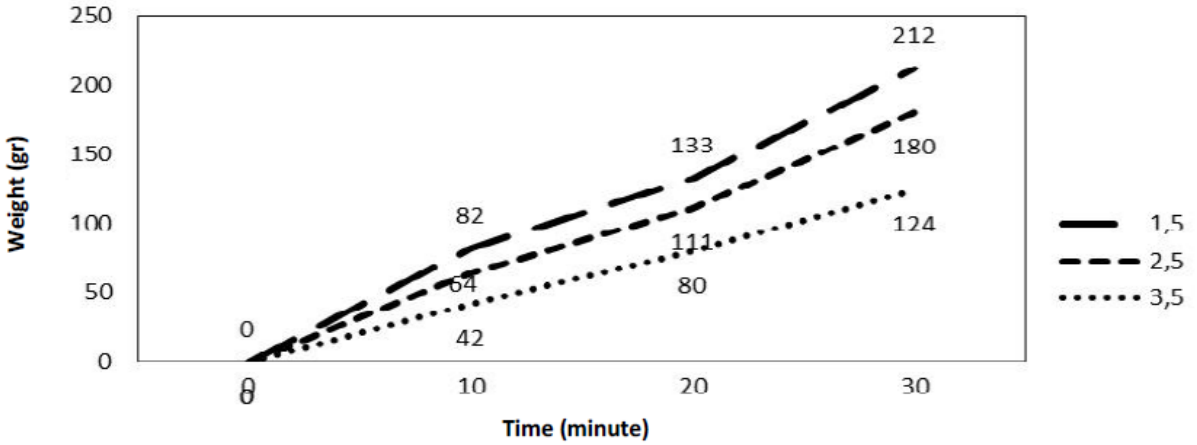

Figure 8. Relationship of Weight and Time to Various Water Pressure from Pumps

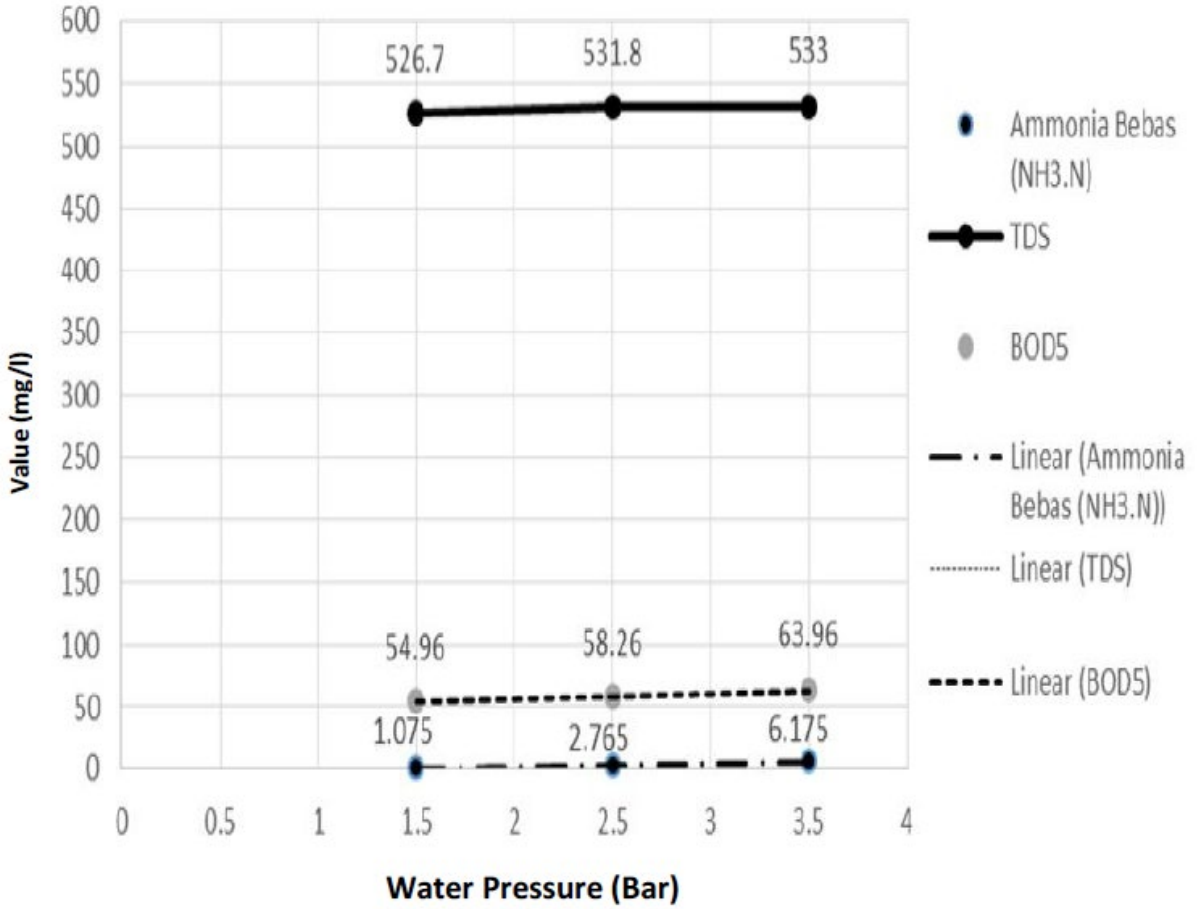

Figure 9. Relationship of TDS, BOD5, & Ammonia Bebas (NH3.N) Value with Water Pressure

Qualitative and Quantitative Test Result of Microalgae Types

From the table above, the results of the dominant types of algae are *Gramatophora angulosa* which is used as organic fertilizer, because the chemical content contained in marine algae is a very important nutrient for all living things including plants, the algae the sea can be used as an alternative source for replacing agricultural fertilizers containing synthetic chemicals. Algae can be used as organic fertilizer because they contain mineral ingredients such as potassium and hormones such as auxin and Sytokinin which can increase

Table 4. Amount of Plankton Spesies

No.	Spesies	Class/group	Amount of ind.
1	*Actinosphaerium* sp.	Rhizopoda (Protozoa)	4
2	*Ankistrodesmus falcata*	Chlorophyceae (alga hijau)	4
3	*Arcella* sp.	Rhizopoda (Protozoa)	2
4	*Chroococcus giganteua*	Cyanophyceae (alga biru)	7
5	*Chroococcus limnertia*	Cyanophyceae (alga biru)	15
6	*Clamydomonas* sp.	Chlorophyceae (alga hijau)	17
7	*Closterium cornu*	Chlorophyceae (alga hijau)	20
8	*Closterium gratile*	Chlorophyceae (alga hijau)	2
9	*Closterium* sp.	Chlorophyceae (alga hijau)	1
10	*Cocconeis* sp.	Chrysophyceae (alga kersik)	4
11	*Coscinodiscus* sp.	Phaephyceae (alga coklat)	9
12	*Cosmarium* sp.	Chlorophyceae (alga hijau)	2
13	*Cyclotella nenaghiniana*	Chrysophyceae (alga kersik)	21
14	*Cyclotella* sp.	Chrysophyceae (alga kersik)	5
15	*Euchelya* sp.	Ciliata (Protozoa)	3
16	*Euglena* sp.	Flagelatta (Protozoa)	7
17	*Gramatophora angulosa*	Phaephyceae (alga coklat)	118
18	*Gramatophora* sp.	Phaephyceae (alga coklat)	68
19	*Gymnodium* sp.	Flagelata (Protozoa)	8
20	*Loxophylum* sp.	Rhizopoda (Protozoa)	3
21	*Malosira granulata*	Phaephyceae (alga coklat)	5
22	*Melosira agussiazii*	Chrysophyceae (alga kersik)	3
23	*Melosira* sp.	Chrysophyceae (alga kersik)	5
24	*Nitschia* sp.	Phaephyceae (alga coklat)	12
25	*Paramaeciums* sp.	flagelata (Protozoa)	25
26	*Polymyxa* sp.	Rhizopoda (Protozoa)	2
27	*Protococcus* sp.	Chlorophyceae (alga hijau)	5
28	*Rhizosolenia* sp.	Chrysophyceae (alga kersik)	13
29	*Scenedesmus arnatus*	Chlorophyceae (alga hijau)	13
30	*Scenedesmus dimorphhus*	Chlorophyceae (alga hijau)	23
31	*Scenedesmus quadricauda*	Chlorophyceae (alga hijau)	20
32	*Scenedesmus* sp.	Chlorophyceae (alga hijau)	19
33	*Sphaerocystis schroeteri*	Chlorophyceae (alga hijau)	115
34	*Spirogyra* sp.	Chlorophyceae (alga hijau)	2
35	*Stauraspis* sp.	Flagelata (Protozoa)	2
36	*Synedra acus*	Chrysophyceae (alga kersik)	2
37	*Tabellaria* sp.	Chrysophyceae (alga kersik)	3
			589

the power of plants to grow, flower and bear fruit. The use of algae as organic fertilizer is also supported by the nature of hydrocolloids on marine algae which can be used for water absorption (high absorption) and become a good substrate for soil microorganisms. Brown algae is also one of the staple food sources for several types of livestock, especially in maritime countries (Venugopal, 2009).

The benefits of the dominant green algae are *Sphaerocystis schroeteri* after going through the algae harvesting stage, which is as a feed material for freshwater fish, and at the time of growth in the WWTP pond as a response to liquid waste because the oxygen produced by algae affects the levels of BOD_5 and COD (Abdullah Rasyid; 2014). **Table 4** explain abaout result of identification all of plankton include the microalgae.

CONCLUSIONS

Conclusions from this study:

1. From the results of algae harvesting water quality test for parameters Dissolved Solids (TDS), Total Suspended Solids (TSS), Free Ammonia (NH_3-N), and Total Nitrogen (Total N), lowest concentration values was found for harvesting using pressure variation filtration method 1.5 bar. This is because many algae are filtered. Whereas for the parameter value of BOD_5 and Total Phosphorus (Total P),

lowest values was found for harvesting using the method of flocculation with chemical alum. That is due to the high coagulant concentration where alum can bind colloidal particles causing the lower BOD_5 value of wastewater. Through this process, insoluble organic and inorganic impurities can be reduced, causing the dissolved oxygen to be reduced to oxidize the impurities so that the BOD value will decrease but the value exceeds the maximum allowable value, so that for the BOD_5 value does not meet the requirements, while for the low total P value due to the coagulation process in this study produces precipitates from alum which has bound phosphate.

2. Effective slope variation filtration method is at 10 ° in 30 minutes with a weight of 203 grams, while the effective pressure variation filtration is at 1.5 bar in 30 minutes weighing 212 grams. This is because the weight of the algae is filtered the most.
3. The dominant algae in the whole sample is *Gramatophora angulosa* which belongs to the class of brown algae *(Phaephyceae)* and *Sphaerocystis schroeteri* which are included in the class of green algae *(Chlorophyceae)*. Benefits of brown algae *Gramatophora angulosa* as an ingredient in organic fertilizer and animal feed. Benefits of green algae *Sphaerocystis schroeteri* as freshwater fish feed ingredients.

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No potential conflict of interest was reported by the authors.

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